REVIEW ARTICLE

Living with the Virus: Considerations & Challenges in Restarting "New Normal" Surgical Practice

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ABSTRACT

COVID -19 disease has taken a toll on the healthcare system and the number of cases is increasing at alarming rates. The long incubation period, asymptomatic patients, the aggressive spread of the virus, and lack of definitive treatment are the main reasons, why the infection could not be contained so far.The intended goals of this review are to provide logical & rationale management of patients in the present time, the judicial utilization of the available resources (manpower, infrastructure, safety gears) and preventing or minimizing the risk of infection to the public, patients, co-patients and healthcare workers (HCW's), as well as to explore the requirements for restarting the new normal hospital practice. HCW's need to take precautions assuming all patients as COVID positive unless proven otherwise. Patients should be categorized based on the COVID status and further based on the urgency of surgery into acute, sub-acute & chronic cases. The review & recommendations can be used to reduce the risk of exposure from human to human as well as in planning the strategy on how to restart a safe practice in surgical specialties.

Key words: COVID-19, Corona virus, pandemic, Surgery, recommendations, protocols, Management, restart practice

INTRODUCTION

The severe acute respiratory syndrome virus 2 (SARS-CoV-2) has led to the global pandemic of the coronavirus disease (COVID-19)[1]. As of June 16, 2020, there have been 7,941,791 confirmed cases and 434,796 deaths reported to the WHO[2]. The virus has a high reproductive number (R0) of 3 to 4, which means that one case can potentially infect upto 4 cases[3]. The trends from China & Italy show that we will have to live with the virus for a significantly longer duration. This means that all the healthcare systems will have to be back in pace as there has been an immense pending patient demand. Our health care organizations, physicians and surgeons must be prepared to meet this demand.

Novel infection explains the absence of immunity, an effective anti-viral drug and vaccinations against it. Health care workers (HCW) are exposed to patients who are moderate to severely afflicted[4]. Further invasive procedures leading to aerosol generation such as intubation or endoscopy further predispose health care professionals (Figure 1). Prolonged working hours, inappropriate diet, and certain comorbid conditions further compromise the immunity. A recent systematic review performed using the available literature suggested that the overall proportion of HCW who were SARS - CoV -2 positive among all COVID -19 patients was nearly ten percent. Importantly, the same review found that more than half of the COVID -19 positive HCW reported that they had contact with COVID -19 positive patients in healthcare settings[5]. Therefore, it is imperative that HCW take the utmost care when performing their duties. Furthermore, it is prudent to form guidelines for rationale management of positive & suspected patients requiring outpatient services, emergency procedures and surgeries so that the HCW does not succumb to the infection. We hereby present a comprehensive review of the various guidelines that have been issued. The aim of this review is to analyze evidence and discuss strategies that when adopted can reduce the transmission of the virus to health care workers dealing with confirmed or suspected COVID-19 cases.

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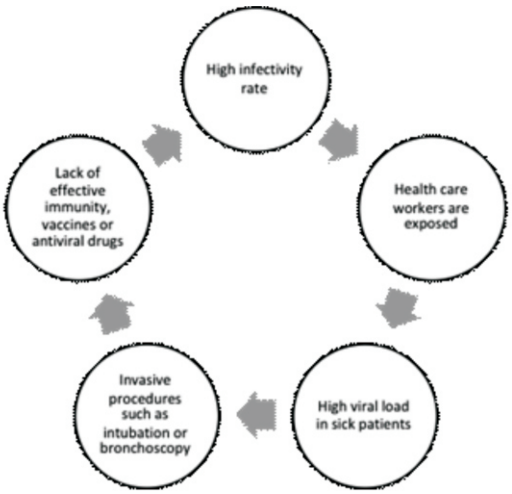

Figure 1: Vicious cycle leading to increased risk of COVID-19 infection in health care worker

Structure and Pathophysiology of COVID-19: SARS-CoV-2, is an enveloped non-segmented single-stranded positive-sense RNA virus. The structure of the virus includes four essential structural proteins, including spike (S) glycoprotein, small envelope (E) protein, matrix (M) protein, and nucleocapsid (N) protein and 16 non-structure proteins (NSPs)[6,7].

Pathophysiology and virulence mechanisms of COVIDmay be linked to the structure of non-structural proteins (NSPs) and structural proteins. As far as the function of the structural proteins is concerned, the envelope has a crucial role in virus pathogenicity as it promotes viral assembly and release. However, the exact pathophysiological mechanisms are still not clear as no animal model exists and most of the research has been carried out on Vero E6 cells.

Virus host interactions: Two host proteins play a major role for cell entry and replication of the virus: i) angiotensin-converting enzyme 2 (ACE2) which serves as the SARS-CoV entry receptor by binding to the S1 spike and ii) the endosomal compartment transmembrane protease serine 2 (TMPRSS2) which causes priming/cleavage of the S1 spike glycoprotein enabling the fusion of the viral envelope with the endosomal compartment. After this, the virus replicates and releases multiple copies in the host[8]. ACE2 receptor is found on alveolar cells of the lung epithelium (most abundant in type II alveolar cells), glandular cells of the gastric, duodenal and rectal epithelium, heart and peripheral nerves. Non ACE2 pathways for virus infection cannot be excluded and this is still an extensive area of research.

Having entered the host, the interaction of the virus with the host cell triggers the immune system. Macrophages release numerous cytokines in response, particularly IL-6. Other cytokines and chemokines include IL-1, IL-2, IL4, IL-7, IL-10, IL-12, IL-13, IL-17, GCSF, macrophage colony-stimulating factor (MCSF), IP-10, MCP-1, MIP-1α, hepatocyte growth factor (HGF), IFN-γ and TNF-α which might lead to a cascade representing an overzealous and overwhelmed immune response. This is termed as the macrophage activation syndrome/cytokine storm which is a form of secondary hemophagocytes and potentially a fatal immune response[9]. Inflammatory response signaling pathways include recruiting adaptors such as IFN-β (TRIF), mitochondrial antiviral-signaling protein (MAVS) and stimulator of interferon genes protein (STING) trigger downstream cascades molecules, involving adaptor molecule My D88 and lead to the activation of the transcription factor nuclear factor-κB (NFκB) and interferon regulatory factor 3 (IRF3)**[10].** Some patients can even develop a coagulopathy meeting the criteria of disseminated intravascular coagulation (DIC)[11].

Preparedness for Coronavirus disease 2019 (COVID-19) in the outpatient clinics and day care procedures

Outdoor practices to reduce spread of COVID-19 infection: Each institute should draft a policy on how to deal with patients in outdoor, treatment policies, triage areas[12]. All health care professionals working in the hospital should be updated and educated about the same[13].

Healthcare facility areas should be well ventilated[14]. In settings where windows cannot be opened and where ventilation is in a closed circuit, high-efficiency particulate air (HEPA) filters should be used for recycling the air. The common areas such as the reception, waiting rooms, procedure rooms, and recovery rooms should be first cleaned with neutral detergent followed by decontamination of surfaces with disinfectants effective against viruses. These may comprise of an appropriately diluted solution of household bleach or 70% ethanol. It is also imperative to clean the wash basins, toilets, and bathrooms. The use of single-use disposable cleaning equipment (e.g. disposable towels) is recommended. If unavailable, then the cleaning material (cloth, sponge

etc.) should be placed in an appropriate disinfectant solution else it should be discarded and not reused[14].

Chairs in waiting areas should be kept far apart. Magazines, information booklets, and other materials should be removed from the waiting area. Appropriate signages about the symptoms of COVID-19, what should be done, and what should not be done should be put at points with easy visibility for the patient. Sanitizers, wash basin with soap and appropriate waste disposal bins should be made available. Equipment such as blood pressure cuffs and stethoscopes should be sanitized in between patients.

Social distancing, hand sanitization and use of face masks should be mandatory to reduce cross-infection. Crowd control is required and appropriate spacing between various patients is needed. Sanitization of the outpatient area and innocuous appearing areas in the outdoors, registration counters, and pharmacy are required. Training of doctors, nursing staff, and ward help in terms of disease symptoms, measures to prevent, donning, and doffing of personal protective equipment (PPE) should be done[12,13]. Areas should be designated for donning and doffing of PPE, dispensers for sanitizers, wash basins with soap, and dustbins.

Patients with acute onset of respiratory symptoms including cough, fever, and respiratory difficulty should inform beforehand about them. A separate counter should be prepared to deal with these patients with acute respiratory infection (ARI) and severe acute respiratory illness (SARI)[15]. The health care professionals dealing with these patients should wear personal protective equipment. Patients with non-urgent symptoms should have their appointments rescheduled.

Patients upon arrival should first undergo screening whether symptoms are present. Those with symptoms of ALI or SARI should be triaged to the COVID-19 desk. If a patient is COVID suspect patient, then he/she should either be admitted to a COVID ward or shifted to a COVID dedicated hospital. The patients attending the hospitals can be classified into three as per Table 1.

Table 1: Three cohorts of cases in the current covid era

COHORT	Symptoms	Laboratory features
A	Asymptomatic for COVID symptoms	RT-PCR negative. Blood Counts or CxR not typical of COVID infection No clinical or history evidence(Hotspot inhabitant) suggestive of COVID disease
B	Suspected for COVID disease	RT-PCR report awaited RT-PCR report Negative but the patient appears clinically suspicious of Covid infection Hotspot inhabitant Blood Counts or CxR typical of Covid infection
C	Infected Patients	RT-PCR Positive

A check team should be present in every outdoor clinic to ensure that the aforesaid measures such as face mask by everyone, availability of sanitizers at designated areas, distancing at counters, no spitting, and waste disposal in bins are implemented by one and all.

Transit wards or suspect areas should be designated in each hospital while admitting COVID suspects. Health care professionals taking care of these patients should be provided with proper PPE. Sanitization and cleaning of these wards are essential.

Strict measures should be taken to limit the entry of visitors and attendants into the healthcare facilities. Specifically, visitors should strongly be discouraged from visiting patients who are at high risk for severe illness from COVID-19. A separate visitor entrance should be designated and visitors should only be allowed when

necessary. All visitors should be screened for COVID symptoms and fevers and those who are found to have fever or symptoms of acute respiratory illness should be immediately asked to leave the facility and seek care, as needed[16].

Role of Telemedicine: Telemedicine would play a quinte essential role in patients especially those on follow-up. This method of consultation avoids direct physical contact, provides continuous care to the community, and reduces morbidity and mortality in the COVID-19 outbreak[17]. Video consultations are relatively easy to set up and are also cost efficient. Health providers and patients should work together to make the best use of current advancement in technology and recognize the importance of telemedicine.

Practices for safely conducting endoscopy procedures: Procedures such as bronchoscopy and GI endoscopy are aerosol-generating procedures (AGP). The procedures should be divided into emergent, semi-urgent, and elective[18]. The elective procedures should be deferred until the pandemic subsides in the area. Emergent and semi-urgent may be performed. A negative COVID-19 report within the past 3 days should be mandatory in areas with a high prevalence of COVID-19 infection; since symptoms are often absent in those infected. Bronchoscopy done to collect bronchoalveolar lavage for COVID-19 RT PCR should be used only when other non-invasive sampling techniques are inconclusive, as it would create risk for the health care professionals[19,20].

The shortest procedure should be attempted. Adequate sedation is required and cough should be minimized by drugs taken before the procedure. Nebulization of lignocaine for anesthesia before the procedure should be avoided, as it is also an AGP[21]. A minimum number of people should be present in the endoscopy suite. The most experienced operator should perform the procedure to have the procedure completed in the shortest time. Training of residents should be deferred until the pandemic subsides in the area. Bronchoscopy boxes are now available through which the instrument can be inserted, however, its utility in controlling the infection has not yet been proved. If the box is not available, the endoscope should be inserted via a slotted well-fitted face mask. The endoscopy room should have negative ventilation[22]. The health care professional present in the room should be wearing PPE comprising of N-95 respirator, face shield, hazmat suit, and gloves. Single-use bronchoscopes may be used depending on local availability and logistics. Scopes should be appropriately sterilized and the brushes used to clean should be single-use.

Precautions against airborne or droplet transmission of COVID-19 – maintaining a safe distance: According to the WHO guidelines for protecting the HCWs, contact and droplet precautions should be taken by HCWs caring for suspected COVID-19 patients[23]. A medical mask is recommended for routine care, while a respirator (airborne precautions) is recommended if HCWs are conducting an aerosol-generating procedure such as endotracheal intubation, bronchoscopy or airway suctioning, along with droplet precautions[23]. It is also recommended that spatial separation of 1 m (≈ 3 ft) should be maintained with an infected patient, in the belief that large droplets can only spread horizontally to a maximum of 1 m (≈ 3 ft)[24]. However, recent work in this area has raised new questions. A review of published literature revealed the limited scientific data to inform spatial separation guidelines and a growing body of evidence that droplet precautions are not appropriate for SARS-CoV-2[25]. The recent data on SARS-CoV-2 in a hospital ward shows a distance traveled by the virus of at least 4 m (≈ 13 ft), double the assumed safe distance[26]. Thus, further work needs to be done carefully documenting and studying the mechanisms shaping transmission distances.

General considerations in patient management in COVID era

1) Should the elective procedure be done?

All elective Surgeries should be deferred & only emergency and semi-emergency (e.g malignancy) can be scheduled. In case of a difference of opinion the final decision should be taken by the Head of the concerned department.

a) The Risk to the HCWs

The main mode of spread of the virus is through droplets, fomites & aerosols. Patients who can be managed with simple procedures such as needle aspirations should not be subjected to surgical procedures (e.g Needle aspiration of Pleural effusion Vs Chest tube

insertion). AGP's (aerosols generating procedures) should be avoided wherever possible. The common AGP's are: Tracheostomy/Endoscopic procedures/ Laparoscopic procedures/ Bronchoscopy/ Sinus surgeries/ Surgeries involving High speed Drills & Electrocautery/Ultrasonic aspirator/ Rectal surgeries/Intubation & Extubation/ Thoracotomies & Chest tube insertions. If a procedure is essential, wherever possible regional anaesthesia should be preferred over GA. Filter devices & negative pressures in the operating room should be used whenever AGP's are performed. The virus persists for a few hours in the air and upto a few days on the surfaces. Hence the rationale of using smoke evacuation machines, filter device & negative pressure in OT room, etc. A minimum of one-hour time gap to be given between two procedures, 30 mins of deep cleaning & 30 mins of Sterilisation/ Fumigation).

Case urgency should be ranked as follows[27]:

Acute: Requiring surgery within 24 hours

Sub-acute: Requiring surgery within 7-10 days

Chronic: Requiring surgery within or more than a month

b) The Risk to the patient

1) There is evidence that surgery in COVID-19 infected asymptomatic patients is associated with a more severe disease manifestation in the post-operative period with a mortality rate of up to 20%. Hence all attempts must be made to treat the problem conservatively wherever possible (e.g. Appendicitis, chloecystitis, ureteric calculus, spinal injury with either no gross neurological deterioration or in cases of total paraplegia where the chances of recovery are very bleak).

2) How should the preoperative assessment be done?

Preoperative assessment should include detailed history including travel history, contact with infected COVID -19 case, or history of fever, myalgia, cough, bodyache, URI. All patients should undergo two COVID RT-PCR based tests in the pre-operative period: first at the time of admission and 2nd one day before surgery with a chest x-ray or CT chest as appropriate before undergoing non-emergency surgeries. All acute emergency cases (where COVID report cannot be obtained before procedure) should be assumed as positive and appropriate precautions should be taken.

3) How much can a negative RT-PCR for COVID be relied upon?

In Stage 3 of the pandemic, the possibility of false-negative should be kept in mind & all due precautions should be taken considering every patient as potentially infected. If there is a clinical suspicion of COVID with a negative RT-PCR report, the patient should be treated as a suspected case rather than a COVID negative case. The Blood counts (DLC) showing relative lymphopenia & monocytosis, suggestive changes in CxR/ CT Chest should be given due importance.

4) What are the pre-operative considerations?

Surgery for COVID negative patients only should be performed in routine OT complex. Surgery for unproven COVID negative should be performed in a designated OT for suspect patients, in a separate OT from the OT complex for negative patients. Surgery for COVID positive patient must be done in a dedicated COVID positive hospital, as far as possible. The OT should have a negative pressure environment, if the same is not available; a high frequency of air exchange (25/hour) is also effective to rapidly reduce the viral load[28]. All OT personnel should take extended standard precautions and wear protective gear such as PPE kits, N-95 masks, with or without a face shield. Each OT complex should have 3-5 OT tables, dedicated nursing staff & other OT Personnel. The operating rooms should not have an interconnected ducting system for ventilation. As far as possible, emergency surgeries should be avoided during the night. All patients belonging to Category A & RT-PCR negative Category B, who have undergone surgery should have their RT-PCR done after 72 hours of operation, to pick up the false-negative patients. Consent regarding accidentally acquiring COVID-19 infection during the hospital stay should be taken & explained. (For Cohort A & possibly for B)

5) What precautionary measures should be taken during surgical procedures?

Positive pressure ventilation should be avoided before intubation. Laminar flow or AC should not be started until intubation is done. Minimal OT personnel should be allowed inside the operating room. The surgical team should wait outside until intubation is done. An adequate amount of consumables such as sutures, drugs, Oxygen cylinders should be kept inside the OT room and

nobody should be allowed to leave or enter the OT room during the procedure. An outside staff member (runner) may be used to provide emergency material during the surgery if any.

Electro cautery should be avoided or should be used at the lowest power settings to avoid smoke, similarly craniotomies & high-speed drills to be avoided. The usage of intra operative drains should be minimal. No Exchange of Room Staff should be allowed.

6) What precautionary measures should be considered in post-operative period?

Only the anaesthesia team should remain in the OT during extubation, remaining members should go out but not remove their PPE's so that they are available in case there is a need. The proper exit sequence from OT should be 1st: Surgical team, 2nd: Patient, 3rd: Anaesthesia team, and 4th: Cleaning & Sanitization crew.

Proper Doffing should be done in the designated area and after doffing nobody is allowed to enter the OT room. The surgical instrument should be sent for autoclave preferably in a separate autoclave facility[28].

Organizational support to the health care workers: It is natural that the hospital personals including caregivers, nursing staff, administration, etc., would be stressed by the challenges of a prolonged response to COVID-19, therefore, each healthcare facility should emphasize the physical and mental well- being of the HCWs[29]. The leadership should emphasize on self-care as the most important entity during the COVID response. Conversations with the HCWs could help reduce anxiety, could contribute to a sense of control, and help to build trust. Personnel should be rotated effectively to limit the number of working hours and to ensure adequate rest. Provision of food, decompression time, and personal breaks may be important and may play an important role in maintaining team performance.

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